CLAIMS

1. A high voltage rotating electric machine comprising a stator, a rotor and at least one winding having inner electrically conducting means and surrounding electrical insulation, characterized in that said electrically conducting means comprises conductor means and cooling means for cooling the conductor means to improve the electrical conductivity of the conductor means, and in that said electrical insulation is solid and comprises spaced apart inner and outer layers each having semiconducting properties and, between said inner and outer layers, an intermediate layer of electrically insulating material.

2. An electric machine according to claim 1, characterized in that the amid semiconducting inner layer is electrically connected to, so as to be at substantially the same electric potential as, the conductor means.

3. An electric machine according to claim 1 or 2, characterized in that the said semiconducting outer layer is connected to a controlled electric potential along its length.

4. An electric machine according to claim 3, characterized in that the said semiconducting outer layer is connected to said controlled electric potential at spaced apart regions along the length of the outer layer.

5. An electric machine according to claim 3 or 4, characterized in that the said controlled electric potential is earth potential.

6. An electric machine according to claim 3 or 4, characterized in that the electric machine has more than one winding and in that a separate controlled potential is selected for each winding.

7. An electric machine according to any one of the preceding claims, characterized in that at least one of said semiconducting inner and outer layers has substantially the same coefficient of thermal expansion (α) as that of the said insulating layer.

8. An electric machine according to any one of the preceding claims, characterized in that each pair of adjacent layers of said electrical insulation are secured to each other along substantially their entire contact surfaces.

9. A high voltage rotating electric machine with at least one magnetic circuit comprising a magnetic core and a winding, characterized in that the winding comprises a cable having inner electrically conducting means comprising conductor means, and cooling means for cooling the conductor means to improve the electrical conductivity of the conductor means, and outer solid, e.g. extruded, electrical insulation comprising spaced apart inner and outer layers of semiconducting material and, between the inner and outer layers, an intermediate layer of electrically insulating material.

10. An electric machine according to claim 9, characterized in that the, or one of the, magnetic circuits is arranged in a stator of the rotating electric machine.

11. An electric machine according to claim 9 or 10, characterized in that the, or one of the, magnetic circuits is arranged in a rotor of the rotating electric machine.

12. An electric machine according to claim 9, 10 or 11, characterized in that the outer semiconducting layer is connected to earth potential at spaced apart regions along its length.

13. An electric machine according to claim 5, claim 7 or 8 when dependent on claim 5, or claim 12, characterized in that, with connection of the outer semiconducting layer to earth potential, the electric field of the machine both in the sloth and in the end winding region will be near zero.

14. An electric machine according to any one of the preceding claims, characterized in that the said conductor means comprises superconducting means.

15. An electric machine according to claim 14, characterized in that the cooling means comprises central tubular support means for conveying cryogenic coolant fluid, e.g. liquid nitrogen, and in that the superconducting means is of elongate form and is wound around the tubular support means.

16. An electric machine according to claim 14 or 15, characterized in that the said superconducting means comprises high-transition temperature superconducting (or HTS) material.

17. An electric machine according to claim 16 when dependent on claim 15, characterized in that the HTS material comprises HTS tape or wire wound around said tubular support means.

18. An electric machine according to any one of the preceding claims, characterized in that thermal expansion means are provided between the said electrically conducting means and the said surrounding electrical insulation.

19. An electric machine according to claim 18, characterized in that said thermal expansion means comprises an expansion gap.

20. An electric machine according to claim 19, characterized in that the expansion gap comprises a void space.

21. An electric machine according to claim 19, characterized in that the expansion gap is filled with impressible material, e.g. foamed plastics material.

22. An electric machine according to claim 21, characterized in that the said compressible material includes electrically conductive or semiconductive material.

23. An electric machine according to any one of the preceding claims, characterized in that thermally insulating means is provided outwardly of the conducting means.

24. An electric machine according to any one of the preceding claims, characterized in that the or each winding is wound in slots formed in the stator or rotor, and in that each slot comprises a number of substantially circular cylindrical openings extending axially and radially outside one another, each pair of adjacent openings being joined by narrower waist portion.

25. An electric machine according to claim 24, characterized in that the radii of the said openings of each slot decrease in a direction away from a yoke portion of a laminated core.

26. A high voltage rotating electric machine comprising a stator, a rotor and windings, characterized in that at least one winding comprises one or more coils and that the or each coil comprises conducting means having conductor means and cooling means for cooling the conductor means to improve the electrical conductivity of the conductor means, electrical insulation surrounding the conducting means and an equipotential outer layer surrounding a side and end of the coil.

27. An electric machine according to claim 26, characterized in that said conductor means comprises superconducting means.

28. An electric machine according to any of the preceding claims, characterized in that the rotating electric machine is connectable to one or more system voltage levels.

29. An electric machine according to claim 28, characterized in that one winding is provided with separate tappings for connection to different system voltage levels.

30. An electric machine according to claim 28 or 29, characterized in that a separate winding is provided for connection to each system voltage level.

31. An electric machine according to any one of the preceding claims, characterized in that the said intermediate layer is in close mechanical contact with each of said inner and outer layers.

32. An electric machine according to any one of claims 1 to 30, characterized in that the said intermediate layer is joined to each of said inner and outer layers.

33. An electric machine according to claim 32, characterized in that the strength of the adhesion between the said intermediate layer and each of the semiconducting inner and

outer layers is of the same order of magnitude as the intrinsic strength of the material of the intermediate layer.

34. An electric machine according to claim 31 or 33, characterized in that the said layers are joined together by extrusion.

35. An electric machine according to claim 34, characterized in that the inner and outer layers of semiconducting material and the insulating intermediate layer are applied together over the conducting means through a multi layer extrusion die.

36. An electric machine according to any one of the preceding claims, characterized in that said inner layer comprises a first plastics material having first electrically conductive particles dispersed therein, said outer layer comprises a second plastics material having second electrically conductive particles dispersed therein, and said intermediate layer comprises a third plastics material.

37. An electric machine according to claim 36, characterized in that each of said first, second and third plastics materials comprises an ethylene butyl acrylate copolymer rubber, an ethylene-propylene-diene monomer rubber (EPDM), an ethylene-propylene copolymer rubber (EPR), LDPE, HDPE, PP, PB, PMP, XLPE, EPR or silicone rubber.

38. An electric machine according to claim 36 or 37, characterized in that said first, second and third plastics materials have at least substantially the same coefficients of thermal expansion.

39. An electric machine according to claim 36, 37 or 38, characterized in that said first, second and third plastics materials are the same material.

40. An electric machine according to any one of the preceding claims, characterized in that it is designed for use at high voltages, suitably in excess of 10 kV, in particular in excess of 36 kV, and preferably more than 72.5 kV up to very high transmission voltages, such as 400 kV to 800 kV or higher.

41. An electric machine according to any one of the preceding claims, characterized in that it is designed for use at a power range in excess of 0.5 MVA, preferably in excess of 30 MVA and up to 1000 MVA.

42. Use of a rotating electric machine according to any one of the preceding claims, characterized in that the machine can be operated with up to 100% overload for a period of time exceeding 15 minutes and up to about two hours.

43. Use of a rotating electric machine according to any one of claims 1 to 41, characterized in that the rotating electric machine is directly connected to a power network via connecting devices and without an intermediate transformer between the machine and the network.

44. Use of a rotating electric machine according to any one of claims 1 to 41, characterized in that voltage regulation of the rotating electric machine is performed by control of the magnetic field flow through the rotor.

45. Use of a rotating electric machine according to any one of claims 1 to 41, characterized in that the machine can be operated without mechanical load and that the machine is provided for compensation of inductive or capacitive load on the network.